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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing

(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION

See paragraph 2 below

International application No.
PCT/EP2004/013630

International filing date (day/month/year)
01.12.2004

Priority date (day/month/year)
01.12.2003

International Patent Classification (IPC) or both national classification and IPC
G10L19/02

Applicant
AIC

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☒ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

10/581141
International application No.
PCT/EP2004/013630

10/581141
PCT/EP2004/013630 31 MAY 2006

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
☐ a sequence listing
☐ table(s) related to the sequence listing
 - b. format of material:
☐ in written format
☐ in computer readable form
 - c. time of filing/furnishing:
☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. II Priority

1. ☐ The following document has not been furnished:
- ☐ copy of the earlier application whose priority has been claimed (Rule 43bis.1 and 66.7(a)).
 - ☐ translation of the earlier application whose priority has been claimed (Rule 43bis.1 and 66.7(b)).
- Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.
2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43bis.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.
3. ☐ The International Searching Authority has not been able to consider the validity of the priority claim because a copy of the earlier application whose priority has been claimed was not available to the International Searching Authority at the time that the search was conducted (Rule 17.1). This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.
4. Additional observations, if necessary:
- see separate sheet**

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1,6-7,9-10,12-18
	No: Claims	2-5,8,11
Inventive step (IS)	Yes: Claims	9-10,14,17-18
	No: Claims	1-8,11-13,15-16
Industrial applicability (IA)	Yes: Claims	1-18
	No: Claims	

2. Citations and explanations

see separate sheet

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING
AUTHORITY (SEPARATE SHEET)**

International application No.

AP20 Rec'd PCT/PTO 31 MAY 2006
PCT/EP2004/015830

- 1 Reference is made to the following documents (D1-D5):

D1: WO95/30983 (George, Smith)

D2: David P A M-S; Szczupak J: Refining the digital spectrum. IEEE 39th Midwest symposium on Circuits and Systems, Ames, IA, USA 18-21 Aug. 1996. Vol. 2, pages 767-770. New York, NY, USA, IEEE, US, XP010222730.

D3: Wim D'haes: A highly optimized nonlinear least squares technique for sinusoidal analysis: From $O(K^2N)$ to $O(N \log(N))$. Preprint on the 116th Audio Engineering Society (AES) Convention, 8-11 May 2004, Berlin, Germany, pages 1-12.

D4: T Karvonen: Computational Methods in Water Resources. Chapter "5.4.4 Gauss-Newton-Levenberg-Marquardt-method", 17 May 2003. Retrieved from the Internet address: "http://www.water.hut.fi/~tkarvone/sg_h_544.htm".

D5: Mength: "The discrete Fourier Transform". Handout at Stanford University, 09-02-2003. XP2275706.

- 2 The International Search Report contains a P-document, consequently the validity of the right to priority should be examined (see the PCT Guidelines, 6.06 (i)). Priority is claimed to the document BEW0300207 (further referred as the *priority document*).

The right to priority is valid for claims 1 and 11 only, for the following reasons:

- 2.1 The present application discloses "a nonstationary nonharmonic model according to Eq. (4)", which is not disclosed by the priority document (*claim 2 and all claims dependent thereon*)
- 2.2 The present application discloses that "the parameter λ_1 allows to switch between different optimization methods and the parameter λ_2 regularizes the system matrix", which is not disclosed by the priority document (*claims 6-7 and all claims dependent thereon*)
- 2.3 The present application discloses "a step of computing instantaneous frequencies and instantaneous amplitudes according to Eq. (69)", which is not disclosed by the priority document (*claim 9 and all claims dependent thereon*)

- 2.4 The present application discloses "a step of computing damping factor according to Eq. (78)", which is not disclosed by the priority document (*claim 10 and all claims dependent thereon*).
- 2.5 It should be noted that the right for priority is valid for the *subject-matter* of claims 4-5, 12-13, 15-18 as long as they are dependent on claim 1 only, but not for claims 4-5, 12-13, 15-18 as such (since they are also dependent on claims for which priority is not valid).
- 3 The application does not meet the requirements of Article 6 PCT, because claims 1-18 are not clear, and claim 11 is not concise.
- 3.1 The term "i.a." used in claim 1 is vague and unclear and leaves the reader in doubt as to the scope of the claim, thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT. A possible way to remedy this inconsistency would be deleting the term "i.a." from the claim.
- 3.2 The term "and/or" used in claim 2 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers (the models mentioned in claim 2 are such that only one of them can be used at a time for modelling speech), thereby rendering the definition of the subject-matter of said claim unclear, Article 6 PCT. A possible way to remedy this inconsistency would be replacing the term "and/or" with the term "or".
- 3.3 The terms "such as" and "preferably" used in claims 1, 5-8 are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer (subject-matter after these terms should be regarded as entirely optional, see the PCT Guidelines, 5.40), thereby rendering the definition of the subject-matter of said claims unclear, Article 6 PCT. A possible way to remedy this inconsistency would be deleting such terms from the claims.
- 3.4 Present claim 7 is dependent on "any of claims 1-6". In fact, present claim 7 cannot be dependent on claim 6, since present claim 6 refers to "optimizing the frequencies for the stationary nonharmonic model", while present claim 7 refers to "the step of optimization the frequencies for the harmonic signal model". As already mentioned above, the

harmonic and the nonharmonic models cannot be applied at the same time.

- 3.5 Present claim 8 refers to Eq. (63) which equation may contain a clerical error. The partial derivative is taken at the values of $m=\omega_k+\omega_k$ and $m=\omega_k-\omega_k$, respectively. Although a thorough calculation of the equations is not provided, the examiner believes that these values should be $m=\omega_k+\omega_l$ and $m=\omega_k-\omega_l$, respectively. The same argumentation applies to Eq. (59). Furthermore, in Eq. (59) the index $pK+p$ should be $pK+k$.
- 3.6 Although claim 11 has been drafted as a separate independent claim, it appears to relate effectively to the subject-matter of claims 1-10, whereby the method of claim 11 to compute the frequency response of a window is used in the method of claims 1-10. Therefore claim 11 lacks conciseness.
- 3.7 The features in the apparatus claim 12 relate to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. The intended limitations are therefore not clear from this claim. In other words, apparatus claim 12 in its present form is not limited. A possible way to remedy the claim would be amending the wording of the claim as follows:
- "Apparatus adapted to carry out each and every step of the method according to any of the previous claims 1 to 10."
- 3.8 Present claims 13-18 refer to the "Use of a *method* ... or an *apparatus*." This renders the class of the claims unclear. A possible way to remedy this inconsistency would be separating the claims into method and apparatus claims.
- 3.9 Throughout the set of the claims references are made to equations in the description. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here. According to the PCT Guidelines, V-5.10 the claims may contain mathematical formulae. Therefore it is suggested that the relevant equations be put into the claims.
- 3.10 Despite the clarity problems mentioned in 3.1-3.9, as a service to the Applicant, the

examination has been carried out in the sense of the above considered corrections.

- 4.1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and discloses (the references in parentheses applying to this document):

"A method for modelling, analyzing and/or synthesizing, a windowed signal such as sound or speech signals (*page 4, lines 15-23; page 10, lines 30-31 in D1*), by computing the frequencies and complex amplitudes from the signal using a nonlinear least squares method (*page 10, line 3 - page 12, line 10 in D1*)"

Document D1 also discloses the problem that sinusoidal modelling is computationally expensive (*page 3, line 35 - page 4, line 11 in D1*).

The problem to be solved with regard to D1 can therefore be formulated as to make the calculation of the model parameters computationally less expensive.

The skilled person desiring to solve this problem would search further in the prior art and he would find document D2. D2 discloses:

"the computational complexity is reduced by taking into account the bandlimited property of the window. (*page 770, right-hand column, lines 15-24 in D2*)"

The skilled person would combine the documents D1 and D2 since both deal with the parameter estimation of a sinusoidal model, therefore obtaining the subject-matter of present claim 1 in an obvious way, which therefore does not involve an inventive step, hence does not meet the criteria of Art. 33(3) PCT.

- 4.2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 2-5,8,11 is not new in the sense of Article 33(2) PCT, for the following reasons:

[claim 2]: "using a stationary nonharmonic signal model according to Eq. (2) and/or a harmonic signal model according to Eq. (3) and/or a nonstationary nonharmonic model according to Eq. (4)." (page 4, left-hand column, line 1 - page 7, right-hand column, line 13; Fig. 2 in D3)

[claim 3], when dependent on claim 2: "the computation of the spectrum as a linear combination of the frequency responses of the window according to Eq. (11) for the stationary nonharmonic model, Eq. (12) of the harmonic model and Eq. (13) for the nonstationary model, whereby only the main lobes of the responses are computed by using look-up tables. (page 3, left-hand column, line 1 - last line; Fig. 1 in D3)"

[claim 4], when dependent on any of claims 2-3: "comprising a pre-processing step which comprises: sorting the frequencies, eliminating frequencies which are close to one another and determining the number of relevant diagonal bands D. (page 7, right-hand column, Section "3.3 Amplitude Computation Pre-processing" in D3)"

[claim 5], when dependent on any of claims 2-4: "the step of computing the stationary complex amplitudes, preferably by solving the equations given in Eq. (19), using Eq. (20) such that only the elements around the diagonal of B are taken into account, whereby a shifted form \underline{B} is computed containing only D diagonal bands of B according to Eq. (27) and Eq. (20), whereby the computation of the Eq. (20) requires the computation of the frequency response of the window and the square window denoted by W(m) and Y(m) respectively, and solving equation given by Eq. (19) directly from \underline{B} and C (Eq. (28)) by an adapted Gaussian elimination procedure. (page 4, left-hand column, line 1 - page 7, right-hand column, line 13; Fig. 2 in D3)"

[claim 8], when dependent on any of claims 2-5: "the step of computing the polynomial complex amplitudes preferably by solving the equation given in Eq. (55), using Eq. (63) such that only the elements around the diagonal of B are taken into account, whereby a shifted form \underline{B} is computed containing only PD diagonal bands of B according to Eq. (64) and Eq. (63), whereby the computation is required of the frequency response of the square window and its derivatives $\partial^p/\partial m^p(Y(m))$, whereby the computation is required of the frequency response of the window and its derivatives $\partial^p/\partial m^p(W(m))$, and solving the equation given by Eq. (55) directly from \underline{B} and C by an adapted Gaussian elimination

procedure. (page 4, left-hand column, line 1 - page 7, right-hand column, line 13; Fig. 2 in D3)"

[claim 11]: "A method to compute the frequency response of a window with length M zero padded up to a length N by using a scaled table look-up according to Eq. (82). (Section "Zero padding" on pages 6-7 of D5)"

- 4.3 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 6-7 does not involve an inventive step in the sense of Article 33(3) PCT (when the claims are dependent on any of claims 2-5).

D3 is regarded as being the closest prior art to the subject-matter of claim 6. D3 discloses:

"optimizing the frequencies for the stationary nonharmonic model preferably by solving the equation given in Eq. (34), using Eq. (42) such that only elements around the diagonal of H are taken into account, whereby a shifted form \underline{H} is computed containing only D diagonal bands according to Eq. (36) and Eq. (42), whereby the gradient h is computed from the residual spectrum R_m , amplitude A_i and frequencies ω_i , and requires the computation of derivative of the frequency response of the window $W'(m)$, whereby the first term of H requires the computation of the second derivative of the frequency response of the square window denoted $Y''(m)$, whereby the second term of H is computed from the residual spectrum R_m , amplitude A_i and frequencies ω_i , and requires the computation of the second derivative of the frequency response $W''(m)$. (page 4, left-hand column, line 1 - page 7, right-hand column, line 13; Fig. 2 in D3)"

The Newton method applied in D3 is only one out of several iterative optimization methods, as it is disclosed by D3 (page 7, right-hand column, lines 35 to 38) and as it is known to the skilled person from his general knowledge. Therefore, according to the circumstances, the skilled person would find another commonly known optimization method, as disclosed by the background document D4:

"whereby the parameter λ_1 allows to switch between different optimization methods and the parameter λ_2 regularizes the system matrix, and computing the optimization step by solving the system of equations directly on \underline{H} and h according to Eq. (37) by an adapted

Gaussian elimination procedure. (*page 1, line 1 - page 3, line 10 in D4*)"

The same argumentation holds for claim 7 for the "optimization the frequencies for the harmonic signal model" *mutatis mutandis*.

- 4.4 Corresponding to above Section 4.1, present claims 12-13,15-16 (when dependent on claim 1) do equally not involve an inventive step, for the following reasons:

[claim 12], when dependent on claim 1: "Apparatus wherein the method of claim 1 is implemented" (*The method of claim 1 is not inventive, hence neither is an apparatus implementing this method*)

[claim 13], when dependent on claim 1: "for accurate pitch estimation (*page 5, lines 11 to 12 in D1*)"

[claim 15], when dependent on claim 1: "for parametric/sinusoidal audio coders" (*Fig. 1, 17, 28 in D1*)

[claim 16], when dependent on claim 1: "for audio effects" (*claim 3 in D1*)

- 4.5 In the examiner's present opinion, no objection under the PCT regarding novelty, inventive step and industrial applicability can be raised against the subject-matter of claims 9-10, 14, 17-18 (see also clarity objections above in Sections 3.1-3.9). Similarly, the subject-matter of claims 5 and 6 as long as they are dependent on claim 1 only is considered to meet the requirements of the PCT regarding novelty, inventive step and industrial applicability (see above Section 2.5 about priority rights).

- 5.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D2 and D3 is not mentioned in the description, nor are these documents identified therein.

- 5.2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

- 5.3 The Applicant is requested to remove the defects found in 3.1-3.9, 4.1-4.4 and 5.1-5.2 by amending the claims.